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Contributions toward a Monograph of the Oriental Aleurodidæ.—Part I.—

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CHAPTER I.

Introductory.

The Aleurodidæ are a family of the Homoptera which are allied to the well-known Coccidæ or Scale Insects. Owing to their similarity to this family they are usually mistaken for such by Agriculturists and such mistakes can easily be excused owing to this family being so little known.

The Aleurodidæ, like all the bugs, are sucking insects and derive their nourishment from plants by pumping up the sap by means of a proboscis formed of three fine setæ. In the Coccidæ the winged males (the females are unwinged) are destitute of mouth parts, but in the Aleurodidæ the males and females both possess wings and the mouth parts and digestive organs are present. It is however in the immature and stationary stages that the greatest damage is done by these insects. In a country like India where there is practically a perpetual summer, these insects are present in great abundance and they are more destructive than in colder climates. This is due to there being a continuous succession of

generations uninterrupted by winter, which in colder latitudes not only puts an end to their depredations for a season, but also seriously thins their numbers, thus acting as a very efficient check on an abnormal increase. Fortunately however for us the members of this family have not proved so prominently destructive as some of the Scale Insects, and probably this is the reason why hitherto they have been but little studied. Although not of pressing importance it must be admitted that their potential power for expansion and destruction is possibly even greater than that of the Coccidæ. Although not possessing limbs in the early and more destructive stages [1] as in some Coccids (like the Monophlebinæ) still their power of dissemination is greater as, owing to the females being winged and capable of prolonged flight, they can be more easily spread. Thus in a plantation their spread would take place quicker than Scale Insects. As a matter of fact it is rare, when several plants of the same species are grouped together, to find only one or two showing traces of this pest; as a rule the entire clump is affected.

So far only six species belonging to the family Aleurodidæ have been described from India. This it must be admitted is a poor record. When we turn to the Coccidæ we see however that even this important family had been till only recently entirely neglected. Now, thanks to the admirable work of Mr. E. E. Green, the number of our recorded Indian Species of the Coccidæ has risen from seven in 1886 to fifty-two in 1901, and this even is only a tithe of those which will be discovered in time and worked up. The case of the Aleurodidæ is similar or even worse; as latterly, after the death of Mr. Maskell of New Zealand, no one has done any work on the Indian forms. India in reality is exceedingly rich in members belonging to this family. In the short space of time that I have been working up the Aleurodidæ I have examined nearly fifty species. Mr. Green has sent me twenty-eight species from Ceylon, one species from Java and two species from Victoria for determination.

CHAPTER II.

Collection and Preparation.

As the habits of members of this family are so similar to those in the Scale Insects the method of collection and preparation is identical or almost so in the case of both. The only disappointment one may meet in collecting is the far larger number of scale insects one is inveigled into examining. It is impossible to give any definite instructions as to the method of searching for these insects, but the few following notes as to

[1] Except the very first stage and then their power of movement is not very great, the larvæ usually moving but a short distance from the egg.

my method of collecting may be of use. I carry a large number, a dozen suffices, of fairly long and narrow envelopes. These envelopes are all that is required for the collection of larvæ and pupæ.

One soon gets quite expert in noticing the signs which betray the presence of these insects. A spotted yellow leaf, a black deposit of fungus on the upper surface of the leaf, a procession of ants, these and many other little signs are soon picked up. Always search the older and more mature leaves rather than the young foliage, nor should one overlook the dead and withered leaves which lie on the ground. The insects are almost invariably attached to the under-surface of the leaves.

For collecting the adults use small phials. The insects themselves must be picked up with a fine camel hair brush the tip of which has been previously moistened.

After collecting as many larvæ and pupæ as are required, make what notes you wish on the envelope itself. The following at least should be entered. Name of tree, colour of insect, character of fluff if any, the comparative abundance of the insect, locality and date. If the tree cannot be recognised carry away some of the leaves and if possible flowers for identification by a botanist.

As soon as possible after reaching home the insects should be examined and sorted, and if possible mounted. When the insects are dry it is impossible to examine the first larval stage satisfactorily as the legs and antennæ shrivel up.

For examination one will find that powers of $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{1}{6}$ are usually sufficient. A camera-lucida for making the drawings is almost indispensable. After cleaning a microscope slide, drop some dilute Canada balsam on it; examine the leaves with a hand lens, and with a fine pin moistened if necessary with turpentine, pick up a few eggs and transfer them to the slide. Next search for larvæ of the first stage. This is somewhat difficult as they are usually only about ·2 mm. in length. Do not be content with one or two specimens, mount several. Pick up the other larval stages present and also some of the pupæ. If the insects are very dark one will have to boil them in caustic potash before mounting. The following is the method. Half fill a fairly long test-tube or watch glass with an almost saturated solution of caustic potash, drop in *one* insect and boil over a spirit lamp or gas jet. When sufficiently transparent remove the specimen with a piece of wire or a hair spring into a small dish of water. After soaking out the caustic potash mount the specimen in a drop of glycerine. I however find that with black species, if one mounts specimens in dilute Canada balsam, and the slide is put away for some time, the insects as a rule become transparent enough to be

examined for fine details. Those species which have the dorsum covered with spines should be mounted under a cover glass raised above the slide by a cork or metal ring. The cover glass is thus kept some distance from the insect itself. It is impossible however in this case to examine with very high powers. The winged insect should be mounted as soon as possible, as it is impossible to make out the details in a shrivelled specimen. I find Canada balsam excellent for mounting them, but it is advisable to stain some of the insects first. It will be found somewhat difficult to mount the adult so as to show the wings to advantage. I find that by placing the insect on the slide, when the balsam is somewhat hardened, gentle pressure on the head with a fine pin will cause the body to slip backwards and leave the wings spread out evenly. If this is found difficult, an alternative method is to carefully cut off the wings with a fine scalpel, the operation meanwhile being watched with a hand lens. As a rule it will be found that Canada balsam is not suited for those species in which the wings are banded, as the bands show but faintly. In this case mount dry by making a ring of balsam and after placing the wing in the centre, pressing on a small cover glass. Keep a fairly large number of the insects in situ on the dry leaves and also some of the winged insects in empty phials or if preferred in spirit.

CHAPTER III.

Preventive Measures.

I do not think it will be out of place to describe shortly such preventive measures as are useful in eradicating or at any rate keeping down these pests. These insects cannot be killed by means of any of the poisons ordinarily used against mandibulate insects, as they exist by pumping up sap from within the leaves by means of their setæ. The most convenient all-round remedy is the well-known kerosine emulsion which when sprayed on the plants kills the insect by closing up the spiracles. It is true that these insects are extensively parasitized by chalcids and their numbers thus kept down; but despite this check these pests often get out of hand and do extensive damage. The causes which lead to this result are varied. It may be that as in the case of most cultivated plants, their natural food-plant may be largely increased and thus sufficient pabulum be provided; or seasons may be favourable. In this case the pests' increase would be short-lived, as the parasite being provided with plenty of food, would soon increase and reduce the pest to something like its old numbers. If, however, the pest is unwittingly imported with its food-plant into a new country and its natural parasite or parasites be left behind at home, it is possible

that the pest may increase amazingly and do extensive damage. In this case its natural parasite being absent, the most suitable remedial measure would naturally be a search for and importation of the parasite. Care would have to be taken of course that no hyperparasites were imported as well. In my opinion I think it may be taken for granted that in its native habitat and under the check of its parasites, a pest cannot ordinarily, without other assistance, be eradicated by means of these natural parasites, as the balance has been adjusted after many generations of struggle between the parasite and its victim.[1] In the case however of an imported parasite the case is quite different; the environment, climatic conditions, abundance of food and the like will be different from that in its native habitat and the pest will take some time to settle down in its new home. While in this as it were transitory stage the parasite (imported without its own parasites) will probably have a far greater power to check the pest.

I have never observed lady birds feeding on any of these insects but it is possible that they do so.

CHAPTER IV.

Characters and Classification.

The Aleurodidæ are a family of insects belonging to the Order Hemiptera, Suborder Homoptera.

Characteristics of the family :—

Adult. Furnished with four wings in both sexes. Sucking and digestive organs present. Eyes usually constricted or reniform, sometimes completely divided. An ocellus above each eye. Antennæ seven jointed. Tarsi dimerous and furnished with three claws. Fore wings with one median and one basal vein (in the genus *Aleurodicus* there is also a terminal vein). The wings usually white, sometimes spotted or banded with red or grey. The surface of the wings mealy.

Puparium. Scale-like. Brown, black or yellow in colour. The dorsum sometimes covered with a waxy secretion. The most important characteristic is the vasiform orifice described below.

Larva 1st stage. Shape elliptical. Furnished with short stout legs and antennæ. The other larval stages similar to the puparium or last quiescent stage.

Egg. The eggs are bean shaped, curved and are attached to the leaf by a short peduncle or stalk.

In the adult stage these insects can be distinguished from the

[1] It cannot, we think, be said that there is ever a 'struggle' between the parasite and its host; the lessened food supply available for the former is entirely brought about by its own actions. Hon. Edit.

Coccids by their possessing four wings to the latter's two, and from the Psyllids by the venation of the wings. The fore wings of the latter family are supplied with several veins while in the Aleurodidæ there are only two (or in some cases three). In the larval and pupal stages they can be distinguished from both the Coccidæ and Psyllidæ by the presence on the dorsal surface of the last segment of the abdomen of a triangular or subelliptical opening (also present in the adult) known as the vasiform orifice. This orifice has hinged to it anteriorly a plate or flap known as the operculum. This operculum projects and covers to some extent the opening of the vasiform orifice. There is besides in nearly every case a narrow tongue-like organ which lies within the vasiform orifice and which projects caudad more or less into or beyond the vasiform orifice. This is the organ which produces the honey-dew.

The family is divided into two genera: *Aleurodes* and *Aleurodicus*. The species belonging to the genus *Aleurodicus* have with one exception been all described from the warmer parts of America.

GENUS *Aleurodes.*

Adults with only one branch (basal) from vein of forewing. Hind wing with a single vein.

GENUS *Aleurodicus.*

Adults having the vein in both wings with a distal and basal branch.

In a recent work by Mr. T. D. A. Cockerell (Proc. Acad. Philadelphia, May 1902, p. 279), these two genera are divided into several subgenera. I will deal with these subgenera later on when classifying our Indian species. As regards the bibliography, the principal works dealing with this family are Dr. V. Signoret's papers in the Journal of the Entomological Society of France, 1867 and 1883; Mr. W. M. Maskell's papers in the Transactions of the New Zealand Institute 1889, 1890, and 1895; and Mr. A. L. Quaintance's "Contributions toward a study of the American Aleurodidæ," (U.S. Dept. Agri. Technical Series No. 8). From these works the complete bibliography can be obtained.

Both Mr. Maskell and Mr. Quaintance have put forward a plea for describing species belonging to the family, not only from the adult insect, but also from the larva and pupa. However objectionable such a practice is in the case of other insects it is perfectly valid in the case of the Aleurodidæ. Though in some cases it is true that the perfect insects do differ in some small particulars, such as the occasional presence of spots and bands on the wings, it is practically impossible in most cases to differentiate species from this stage alone. In the larval and pupal stages on the other hand there is a considerable diversity of

form and colour and in the character of the waxy secretion. It also happens that generally when these insects are collected, only the larvæ and pupæ are sent for examination, as these are the stages in which damage is done to plants. If however the adult "flies" are obtained, they should always be described, particularly the colour of the wings, as although in most cases they are white some species have the wings more or less spotted with brown or red.

I have gone somewhat into detail in describing the different larval stages. It is difficult except in some few cases to be absolutely sure as to the number of moults. I have however but little doubt that the normal number is four excluding the pupal stage. This I have made certain of in some species but it is of course impossible to find out the number in many cases as material sent usually consists of only one or two of the stages.

CHAPTER V.

Description of 7 new species of *Aleurodes.*

Aleurodes religiosa n. sp. Plate V, figs. 6–9.

Signoret in his "Essai Monographique sur les *Aleurodes*" (Ann. Soc. Ent. France Ser. 4, VIII, 1868), describes and figures an Aleurodid he obtained from *Rubus fruticosus* and which he named *A. rubi.* This species is distinguished from *A. longiceræ*, Walk. by minute differences in the adult insect, the larval (really pupal) state, which he figures being identical except that as he says "sur la ligne mediane on observe sur chaque segment abdominal une impression plus visible a la base qu'au sommet." In allied species the differences in the adult stage are extremely minute and it is hardly safe to rely on these differences alone in defining a species.

A. religiosa is undoubtedly closely allied to these two species possessing as it does the same series of spines on the dorsum. It however differs in having in addition another pair of spines placed fairly close together on the cephalic region, caudad of the outer and longer pair on cephalic region. It also has two yellow ridges one on each side of the vasiform orifice. The caudal half of the dorsum is narrower than the cephalic half and the margin caudad is slightly incurved. The cephalothoracic margins are also incurved the surrounding area being suffused with yellow. The indentures also bear a short fragmentary fringe of wax.

I have described this species in detail as Signoret gives no detailed description of the vasiform orifice. His drawing shows that it is probably identical or almost identical (but smaller in proportion) to that in *A. religiosa*; he does not deal with the earlier stages at all, nor does he give

any measurement. I have found *A. religiosa* fairly common on some pepul and banyan plants in Calcutta. So far however I have been able to obtain it from only one locality. The larvæ and pupæ are usually to be found on the same leaves as *A. quaintancei.*

All stages can be obtained at the same time and from off the same leaf, but one or two stages always largely predominate. In the middle of November pupæ, adults and eggs can be obtained in abundance but the larval stages are scarce.

Egg. Size ·16 mm. × ·06 mm.

Light yellow when first laid turning light-brown afterwards. Peduncle short about ·025 mm. in length; surface minutely sculptured with hexagons. The adult female when laying eggs moves in the segment of a circle, the leaf being whitened by the white meal from the undersurface of the abdomen.

Larva 1st stage. Size ·18 mm. × ·1 mm.

Elliptical, narrow for its length. Colour light yellow, eyes maroon. Legs and antennæ present. One long seta on centre of each tibia of second and third pair of legs. One long seta on tarsi of all legs. Antennæ apparently six-jointed the last joint short and slender. Two long caudal setæ and two short setæ caudo-laterally on margin. There is a narrow fringe of wax around the margin.

Larva 2nd stage. Size ·16 mm. × ·09. mm.

Elliptical, narrow for its length. Colour light yellow. Two darker yellow pigment patches on abdominal region. Eyes maroon, fairly broad waxy fringe right around margin. Dorsum slightly elevated especially along centre of abdominal region. Abdominal segments distinct along dorsum. Two long setæ on second segment of abdomen. Two long setæ caudad on margin. Length of latter pair ·1 mm. Two shorter setæ on caudo-lateral margin. Region round vasiform orifice slightly tinged with yellow. Vasiform orifice relatively large in this stage, shape conical, apex pointing caudad. Anterior edge flat, posterior edge slightly flattened; lateral margins upper edge convex lower edge concave. Operculum brown: anterior and posterior margins flat, lateral margins convex. Length not quite half that of the vasiform orifice. Colour brown, surface covered with fine hairs. Lingula two jointed the first joint short and broad, the second joint narrow broadening out to a conical tip: the surface covered with fine hairs. The lingula projects almost half its length beyond the operculum, the tip extending almost to the lower edge of the vasiform orifice. Legs present but short and rudimentary; antennæ obsolete. The marginal fringe of wax rises from a series of pores just above and within the dorsum. At each segment of the abdomen and about the same distances apart on the cephalo-

thoracic region there are two larger pores which produce larger filaments of wax and so more or less break up the otherwise uniform stretch of fringe.

Larva 3rd stage. Size ·35 mm. × ·21 mm.

Shape elliptical, broadest cephalad tapering gradually caudad. Cephalothoracic margins incurved. Colour light yellow: two yellow pigment patches on abdomen. Area around indentures on cephalothoracic margins and around vasiform orifice suffused with yellow. Eyes maroon. Dorsum slightly elevated, especially along the abdominal region. Segments of abdomen very distinct along centre of dorsum; they cannot be distinguished near margin. A short fringe of wax all around margin. It is relatively narrower than that in the preceding stage. There are two setæ on the second segment of the abdomen: two extremely fine long setæ ·2 mm. in length, just within the margin at incurved cephalothoracic areas and two sightly shorter setæ caudad on margin. All these setæ spring from small tubercles. Vasiform orifice and its appendages similar to that in the preceding stage. There are, however, two fairly long setæ near end of lingula.

Larva 4th stage. Size ·44 mm. × ·3 mm.

Caudal extremity of vasiform orifice flat. There is a narrow marginal fringe of wax. The rest substantially as in puparium. The lateral margins of the operculum in this stage and in the pupa are flat, angled inwards to meet posterior margin: upper edges curved to meet anterior margin: they are not convex as in the other stages of the larva. There is a series of small pores along ventral surface of margin. These produce a small quantity of wax. The margin is fairly broad.

Puparium. Size ·56 mm. × ·35 mm.

Shape elliptical, broadest cephalad. Lateral cephalothoracic and caudal margins incurved. Colour yellowish, semi-transparent under the microscope. Two yellow pigment patches on abdomen: light yellow-brown areas around cephalothoracic and caudal indentures. There is an extremely short scanty fringe of wax at indentures; no trace of a fringe elsewhere on margin. Dorsum elevated, surface granular, abdominal segments fairly distinct. Dorsum covered with several long setæ which spring from small tubercles. They are situated one pair cephalad some distance from the margin; slightly caudad of these a second shorter pair in which the setæ are placed rather close together; one pair on prothorax at inner edge of yellow-brown areas running from the incurved thoracic margins; a pair on metathorax; a pair fairly close together on first segment of abdomen; a pair on fourth segment of abdomen; a pair one on each side of the vasiform orifice, and a pair caudad just within the margin.

Vasiform orifice long, in the shape of a narrow cone ; apex pointing caudad. Cephalic margin flat, corners rounded. Connecting the vasiform orifice to the incurved area on caudal margin is a narrow groove or channel. This channel and the sides of the vasiform orifice are bounded by two yellow, rounded fleshy ridges which run from the upper corners of vasiform orifice caudad to margin. On the end of these ridges are the two tubercles from which the caudal setæ spring. Edge of vasiform orifice light brown. Operculum similar to that in previous stages but lateral margins flatter ; but little more than $\frac{1}{3}$rd. length of vasiform orifice. Colour light-brown, caudal margin darkest; surface covered with fine hairs. There are near the tip two fairly long hairs which project caudad.

Parasited pupæ become very convex, dark coloured and in some cases turn quite black.

Adult female. Length ·8 mm. Wing ·85 mm. × ·31 mm.

Colour light-yellow ; dorsal surface of thorax tinged with brown. Legs light-yellow ; eyes maroon, almost divided, lower half larger. Wing immaculate powdered with white meal. Length of antennæ ·22 mm. Formula 3, 2, 7, 5, 6, 1, 4. Joint 1 short, broad for its length ; joint 2 subpyriform, nearly twice the length of joint 1 ; joint 3 twice the length of joint 2 ; joint 4 one-fourth length of joint 3 ; joint 5 one-and-a-half times the length of joint 4 ; joint 6 slightly shorter than joint 5 ; joint 7 nearly one-and-a-half times the length of joint 6. Vasiform orifice cordate, anterior edge flat. Rim of vasiform orifice tinged with yellow. Operculum in the form of a narrow neck which broadens out into a wide bilobed tip. The posterior margin incurved. Operculum faintly tinged with yellow. Lingula long, fairly stout, conical at tip ; setose, the end extends almost to the inferior edge of the vasiform orifice ; colour yellow.

Adult male. Length ·72 mm. Wing ·74 mm. × ·25 mm. Antennæ ·2 mm. Formula of antennæ, shape of vasiform orifice, etc., as in female.

Aleurodes bengalensis n. sp. Plate II, Figs. 10–16.

Egg. ·2 mm. × ·1 mm.

Colour reddish-brown under the microscope, dark claret colour under a hand lens. Surface covered with meal. The eggs are usually laid in a more or less perfect ring.

For want of material the first, second, and third larval stages have been described from empty skins and in some cases dead and dried individuals. I will describe them later on in detail when these stages can be obtained. Just now, Nov. 20th, pupæ and adults are fairly plentiful and larvæ 4th stage scarce, no living examples of any of the other

larval stages being obtainable. Large quantities of the cast off skins can however be obtained, which is rather unusual amongst these insects.

The insects are present on the leaves in colonies of from half a dozen to several hundred individuals. The location of a colony can be easily ascertained owing to the peculiarly whitened appearance of the leaf wherever a colony has planted itself. This white is the meal from off the adults. I observed no parasited pupæ.

Larva 1st stage. Size ·2 mm. × ·1 mm.

Shape elliptical. Yellow pigment patch on centre of abdomen. A fairly broad marginal fringe of wax. There are 26 spines on dorsum, all around and some distance from the margin. Two series of pores around the margin; difficult to make out but apparently as in later stages. Two long setæ caudad on margin. Two short setæ caudolaterally on margin. The vasiform orifice opens directly on the surface of the dorsum. Shape cordate; anterior edge flattish; edge tinged with yellow. Operculum yellow, similar in shape to the vasiform orifice only narrower being broader than long. Anterior and posterior margins flattish. The operculum extends only a little further than centre of vasiform orifice. Lingula short, broad, constricted in the middle to form a flat broad basal end and a spatulate tip. About half the lingula projects beyond the operculum. Colour of lingula brownish yellow. There appear to be no pores placed centrally on the abdominal segments as in later stages.

Larva 2nd stage. Size ·65 mm. × ·43 mm.

Shape elliptical. A large brown patch on abdomen extending from the first to the sixth segment. Area around vasiform orifice tinged with brown. There are 26 setæ around and slightly within the margin. Caudad on margin 2 setæ. Two shorter setæ caudolaterally on margin. These 4 setæ are placed on a lower plane than the marginal ring of setæ. There is a fairly broad marginal fringe of wax. There are two marginal series of pores situated apparently as in pupa. Of the central double row of abdominal pores present in the pupa only the pair on the first and second segments present. There are rows of extremely minute pores on each segment of the abdomen placed centrally and extending about one-third the width of the dorsum. These pores tend to be disposed in rows but are very irregularly placed. The fourth, fifth, and sixth segments have the largest number.

Vasiform orifice placed in a depressed pit. The pit proportionately far smaller than that in the pupa, the vasiform orifice nearly filling it. Anterior and posterior edges of pit flat, sides convex. The lateral and posterior edges slope inwards. The vasiform orifice situated in a clear

space, the edges of the space being demarcated by a dark line; rest of pit yellowish brown. Vasiform orifice similar in shape to pit, edges dark brown. Operculum broader than long, anterior edge flat, posterior edge concave, sides convex; colour brown. It extends to a little beyond centre of vasiform orifice. Lingula broad for its length, dumb-bell-shaped, being constricted in centre, tip spatulate. It projects for about half its length beyond operculum; colour brown.

Larva 3rd stage. Size ·76 mm. × ·46 mm.

Apparently similar to the 4th stage.

Larva 4th stage. Size ·85 mm. × ·5 mm.

Shape as in pupa. A short marginal fringe of wax. Vertical fringe short. Dorsum much blotched with black. Rest apparently as in pupa.

Puparium. Size 1·1 mm. × ·68 mm.

Shape elliptical, narrower cephalad, the margin being rather abruptly incurved at thorax. Margin caudad flattish. Cephalothoracic area lemon yellow, later turning to orange. Last three segments of the abdomen up to vasiform orifice orange. There is a clear space between these two patches. Two irregular longitudinal grey bands on anterior segments of the abdomen just without the central double row of pores. A broad edging of black around cephalothoracic margin. This is in some cases interrupted so as to form three separate patches, one cephalic and two thoracic. The cephalic patch is divided into two by a narrow yellow band which connects the cephalic margin to central yellow area. A black edging on margin caudad. Caudolateral margins more or less blotched with black. Rest of body of a cream white colour. The grey edging on margin is not at all constant, it varying a good deal. As the insect within develops the markings gradually disappear. They disappear very irregularly, in many cases blotches disappearing from one side before the other. The caudolateral marginal blotches disappear first. The suture between thorax and abdomen sometimes apparent as a fairly broad transparent band. There are 26 setæ right around dorsum; they are set just within the margin. The upper end of each seta for about one-third of its length surrounded with a quantity of fluffy wax. Of these setæ 14 are situated on the abdominal and 12 on the cephalothoracic region. The spines are comparatively short; colour light brown. Two long setæ caudad on margin on a slightly lower plane than the marginal fringe of spines. Mesad of the marginal spines there are present on the dorsum two series of large pores an inner and an outer series. There are in all 28 pores in the outer series, 12 on the abdominal and 16 on the cephalothoracic region. The pores on the abdominal segments are situated,

one on each side near margin of 3rd, 4th, 5th, and 6th segments and two on 7th. There are 26 pores in the inner series, 14 on the abdominal and 12 on the cephalothoracic region. The abdominal pores are situated two on each side near margin of the 3rd segment, one on each side near margin of 4th, 5th, and 6th segments and two similarly placed on the 7th segment. There are also two rows of similar pores down centre of dorsum on the abdominal segments. The rows are placed fairly close together. There are in all 6 pores in each row, 1 pore of each row being placed on abdominal segments 1 to 6. The pores are large, rims slightly elevated above dorsum. All the pores secrete globules of liquid. Ventrally on margin a series of fine pores which secrete a quantity of wax. This fringe of wax is vertical and about ·15 mm. in length. It elevates the pupa off the leaf. The vasiform orifice is prominent and is extremely characteristic. It is situated in a large depressed pit. The pit is conical apex pointing caudad. Apical and basal margins flat, the apical margin being if anything a trifle incurved. Lateral margins rounded, basal ends being curved to meet basal margin. Sides from centre to near apical margin flat, then sharply incurved to meet apical margin. Edges dark brown, an outer edge of light brown. The sides slope inwards. Apical end of pit shallow, the floor sloping down to the anterior end at which point the pit is deepest. Floor of pit highly rugose, with seven dark wavy brown lines forming the demarcations of the ridges. These ridges vary in different individuals. A clear light yellow area around vasiform orifice. Vasiform orifice oval, posterior margin slightly incurved. Anteriorly the margin projects beyond and can be seen below basal edge of pit, showing that the pit's basal edge overhangs at the top. Edge of vasiform orifice tinged with brown. Operculum two-thirds the length of the vasiform orifice. Anterior margin flat, posterior margin slightly concave, sides convex, the curve being somewhat angular. Colour light brown. Lingula spatulate at tip. Only the tip projects beyond the operculum, it is the only part which can be distinguished. Colour brown. Legs of adult can be distinguished through ventral surface. Appearance much the same as that shown in the description of *A. citri*. When the adult is emerging from the pupal case its thorax is of a bright deep orange colour.

Adult female. Length 1 mm. Wing 1·15 mm. × ·42 mm.

Colour light orange; surface of the body dusted with a large quantity of white meal. Eyes maroon, almost divided. Wings immaculate, covered with white meal. Legs and antennæ white, tinged with yellow, dusted with white meal. Antennæ ·3 mm. in length. Formula 4, (2, 3,) 5, 7 (1, 6). Joint 1 short, flat: joint 2 stout, subpyriform: joint 3 thin, cylindrical, equal in length to joint 2: joint 4 slightly longer than

joint 3, joint 5 short, only two-thirds length of joint 4: joint 6 short, little more than one-third length of joint 5: joint 7 twice the length of joint six. Vasiform orifice somewhat square, broader than long, posterior edge widest, anterior edge flattish, posterior edge slightly convex: lateral edges flat and angled outwards. Margin of vasiform orifice slightly tinged with brown: inner area semitransparent. Operculum flattish, broader than long: only about one-third length of vasiform orifice. Anterior and posterior margins concave, lateral margins convex. The upper corners are the only parts of the operculum which touch the vasiform orifice. Colour brown. Lingula long, cylindrical, two jointed, first joint shortest. The lingula projects nearly half its length beyond the vasiform orifice.

Adult male. Length ·9 mm. Wing ·85 mm. × ·31 mm. Antennæ ·25 mm.

Long silky fluff on abdomen as in *A. citri*. This is only present in recently emerged individuals.

Aleurodes alcocki n. sp. Plate II, Figs. 1-9.

Egg. Size ·2 mm. × ·1 mm.

Colour light yellow brown. It stands upright on leaf to which it is attached by a peduncle about ·04 mm. in length. The egg is curved, surface sculptured with minute hexagons.

Larva 1st stage. Size ·27 mm. × ·16 mm.

Shape elliptical, extremely narrow for its length. Provided with antennæ and legs. Colour whitish, semitransparent under the microscope. Margin minutely crenulated. There is a series of closely apposed marginal pores which secrete a short regular fringe of wax. Four fairly long setæ caudad on margin. Caudolaterally on margin eight extremely short setæ (four a side) placed equidistant and forming a regular continuation of the four long caudal setæ. Cephalad there are marginally twelve (six a side) setæ which extend around the cephalothoracic margin. Vasiform orifice slightly elevated, conical, apex pointing caudad. Operculum semicircular, flat anteriorly, almost filling up vasiform orifice. Colour brown, surface covered with fine hairs. Lingula extremely short, cylindrical, about half the length of the operculum beneath which it is hidden. Legs stout; tibiæ of second and third pair of legs furnished each with a long curved hair placed about the centre of the joint. The tarsi of all the legs provided with a long hair just above claw (or claws). Tarsi with apparently only one claw each. Antennæ ·06 mm. (Formula 5, 6, 3, (1, 2, 4,) 7), long, seven jointed, covered with fine hairs. 1st joint short: 2nd joint short, stout, about the same length as the first joint: 3rd joint thin, cylindrical, slightly longer than joint two: 4th joint shorter than joint three, about the same length as joint

two: 5th joint extremely long, four times the length of joint four: 6th joint short, one and a half times length of joint four: 7th joint extremely thin and short, about one-fourth the length of joint six. It is extremely difficult to make out the different joints distinctly, but there is no doubt that joint 5 consists of only a single joint. Eyes maroon coloured. There are several rows of minute pores on the abdomen there being two rows on each abdominal segment. In the figure the artist has represented the vasiform orifice as seen ventrally by him through the transparent body.

Larva 2nd stage. Size ·7 mm. × ·37 mm.

Margin slightly incurved on sides of cephalothorax and at caudal margin. Colour yellow, almost transparent when seen under the microscope. Yellow, pigment patch in centre of anterior abdominal segments. Eyes maroon coloured. Dorsum slightly elevated. The margin is unusually broad. The abdominal segments clearly discernible on elevated portion of dorsum. There is a narrow ridge running from thorax cephalid to the margin where it sometimes projects to a slight point. A series of closely apposed marginal wax tubes which secrete a very fragmentary fringe. Crenulations of marginal pores distinct right up to edge of elevated portion of dorsum. Edge of margin thickened somewhat, brown in colour. Marginal pores on incurved thoracic and caudal margins slightly larger than the rest. Two fairly long setæ on caudal margin, and a pair placed caudolaterally, slightly anterior to these and in line with the lower edge of the vasiform orifice. Vasiform orifice oval, anterior margin flattish. Edge of orifice tinged with brown. Operculum broader than long, of the same shape as the vasiform orifice. The anterior margin flat so that it only touches the rim of the vasiform orifice at the outer edges. Its lower edge extends some distance beyond centre of vasiform orifice. The free (lower) margin slightly elevated. Surface of operculum covered with fine hairs. Lingula short, cylindrical, difficult to make out as it is shorter than the operculum beneath which it lies.

Larva 3rd stage. Size ·85 mm. × ·5 mm.

Shape elliptical, narrower cephalad. Colour yellow: a bright yellow pigment spot on centre of anterior abdominal segments. Brown medio-dorsal ridge running from the thorax cephalad to margin. At thorax a dark brown bar crosses the median dorsal ridge at right angles. Posterior to this is another line which is angled caudolaterally, then back again cephalolaterally. Thorax suffused with light brown, with a deeply trilobed brown line on each side of mediodorsal ridge demarcating the outlines of the developing insect within. Abdominal segments distinct. Edge of margin set with closely apposed pores

which produce a very fragmentary fringe. These pores are situated on a slightly higher plane than the margin. Margin incurved at sides of cephalothorax and at caudal margin. There are eight large and distinct wax tubes on each of these areas. Region around these indentures tinged with brown, which, in the case of the caudal indenture, reaches to the vasiform orifice. Eyes reddish. Two small setæ on the cephalic margin. Two small setæ caudad just within the margin and placed one on each side of the incurved area. They point upwards and outwards. Vasiform orifice similar to that in the larva 2nd stage. In some specimens the orifice is almost circular. In others the anterior margin and the sides are flattened somewhat, giving the vasiform orifice a conical appearance, the apex pointing caudad. The edges of the orifice tinged with brown. The orifice appears to project slightly beyond surface of the dorsum. The operculum similar in shape to that in the larva 2nd stage but is smaller in proportion and does not extend so far caudad. Lingula as in larva 2nd stage. There is but little difference except in size between this stage and the pupa, except that the insect is more transparent, has the median keel on cephalothorax less prominent and the operculum is larger, being intermediate in size between that of the pupa and the larva 2nd stage.

Puparium. Size 1 mm. × ·78 mm.

Shape elliptical, narrower cephalad. Margin at thorax and caudal extremity incurved. Colour yellow. Dorsum elevated. A dark brown elevated median keel running from thorax to cephalic margin beyond which it slightly projects. At thorax a dark brown bar crosses the median dorsal ridge at right angles. Slightly posterior to this is another line which is angled caudolaterally and then back again cephalolaterally. Thorax suffused with brown; centre of abdomen suffused with lighter brown. Segments of abdomen fairly distinct along medio-dorsal line. Vasiform orifice oval: anterior margin slightly flattened. Rim round vasiform orifice dark brown. The lower portion of the orifice covered with fine short hairs. Operculum small, similar in outline to vasiform orifice. The lower edge extends to about the centre of the orifice. Surface covered with fine hairs. Lingula short, cylindrical, difficult to observe as it is shorter than the operculum and does not extend beyond that organ. Incurved areas at thoracic and caudal margins tinged with brown. At these places the marginal pores are eight in number, larger than the other marginal pores and differ in producing fairly long filaments of white wax. A distinct series of pores right around on margin. They secrete a quantity of gelatinous looking wax. Each individual filament is distinct for a certain distance beyond the margin then coalesces to form a gelatinous mass with the others. Dorsum cover-

ed with a similar gelatinous secretion. This is secreted from a large number of very minute pores which appear to lie all over the dorsum without any definite grouping. Colour of secretion yellow. Two setæ, one on each side of incurved caudal area. Parasited pupæ are smaller than nonparasited pupæ, are darker in colour and have the dorsum much arched. The developing parasite can be easily distinguished within the body.

Adult female. Length 1 mm. Wing 1·05 mm. × ·45 mm.

Colour yellow: thorax tinged with brown, body and legs dusted with white meal. Eyes reniform, almost divided. Upper half cherry-red lower half maroon. There is a large rectangular brown patch on last segment of abdomen: within it and at the upper end is the vasiform orifice. Vasiform orifice oval. Operculum small, extending only to centre of orifice. Lingula long, cylindrical, extending a short distance beyond vasiform orifice. Forewing patched with bluish grey. These patches lie in the form of three bars which run across the wing being more or less interrupted at median vein. A longitudinal bar connects all the transverse patches. This bar is situated below the median vein but is prolonged above the vein to apical margin of wing. Apex of hindwing tinged with grey. Antennæ yellow; Formula 3, 2, (5, 6, 7,) 1, 4. 1st joint short, stout: 2nd joint subpyriform, almost globular: 3rd joint thin, cylindrical, two-and-a-half times the length of joint two: 4th joint extremely short, half the length of joint two: joints 5, 6, and 7 one-and-a-half times the length of joint four. There is a dark line on each side of the under-surface of the second and third segments of the abdomen. The under-surface of the last segment of the abdomen with a patch of grey.

Adult male. Size ·95 mm. Wing ·9 mm. × ·33 mm.

Colour yellow: dorsally segments of abdomen and thorax tinged with grey. Last segment of abdomen and gentalia uniform grey. Rest as in female.

I first found this Aleurodid on the leaves of a seedling banyan (*Ficus indica*) lodged on the trunk of a mango tree in the vicinity of Calcutta. I was only able to obtain some half a dozen pupæ at the time. I was much struck by the gelatinous looking secretion of the insect. It is the only Aleurodid which I have obtained which produces such a secretion. It is possibly allied to *A. gelatinosus*, Ckll., although when the two insects are compared they appear to be very dissimilar. *A. gelatinosus* is elevated off the surface of the leaf by its lateral fringe, not so in this species. The margin of *A. gelatinosus* is deeply crenulated, while in this species the crenulations are quite difficult to detect. It differs in colour, *A. gelatinosus* being black: but the two

species agree in producing an apparently similar substance, and the distinctive feature, the indentures on the cephalo-lateral and caudal margins with the pencils of wax issuing therefrom, are common to both. I have, within the last two years, frequently come across this species; at first only on banyan (*Ficus indica*) seedlings, where I searched for it; but later on also on pepul (*Ficus religiosa*) seedlings as well. I find that especially after the rainy season (about October) the insect simply swarms on the young banyan and pepul plants, which spring up during the rains on buildings, rubbish heaps and the like. In the case of the pepul seedlings it is frequently associated with *A. quaintancei*. One peculiarity, however, is that I have only found this species on young plants, and when the two species are both present on the same plant this aleurodid is always to be found on the lower and older leaves. I have failed so far to find the insect on banyan or pepul trees, though I have frequently searched for it. So far, I have only obtained this species from two localities; at Turkaulia, Champaran district, Behar, and in and around Calcutta. The insect is heavily parasited by a minute yellow chalcid. When parasited the dorsum becomes very convex and when the parasite pupates it can be seen quite easily within the body. Although it is to be often found associated with *A. quaintancei* the chalcid parasiting *A. quaintancei* never to my knowledge attacks this species. It is a pity that the insect should suffer so severely from this parasite, as it undoubtedly does some indirect good by killing off the enormous numbers of pepul and banyan plants which take root on old buildings and the like, and which would otherwise in many cases grow up and do future injury. The aleurodid is usually present in large numbers, several hundred being frequently attached to a single leaf, in the greater number of cases eventually killing off the plant. Most of my material has been obtained from the Museum terrace. I may note that I have failed so far to obtain specimens of the 2nd stage; the stages marked 2nd and 3rd being probably the 3rd and 4th. I have much pleasure in naming this species after Major A. Alcock, F.R.S., C.I.E., Superintendent, Indian Museum, to whom I am much indebted for encouragement in my entomological studies.

4. *Aleurodes quaintancei* n. sp. Plate V, Figs. 10–14.

Egg. Size ·18 mm. × ·09 mm.

Cream coloured when recently laid, changing later to light brown. Peduncle about one-third length of egg. The eggs are usually laid four or five abreast in a curved line.

I take this opportunity of naming this species after Mr. A. L. Quaintance, to whom I am indebted for much valuable assistance in my study of this family.

Larva 1st stage. Size ·28 mm. × ·9 mm.

Shape elliptical, narrow for its length. Colour light yellow. Dorsum flat: segments of abdomen fairly distinct. Four long setæ caudad on margin. They rise from small tubercles. Between each pair is a short seta. Four pairs of short setæ (four a side) placed caudo-laterally on margin and forming a continuation of the caudal setæ. Laterally on margin six pairs of short setæ (six a side) the pair furthest cephalad longest. Six long setæ cephalad on margin (three a side), of these the second pair is longest. The caudo-lateral, lateral and cephalic setæ do not form a continous line, there being a space between each set of setæ. Legs and antennæ present. Vasiform orifice as in the pupa only larger in proportion, and the operculum only extends to about the centre of the vasiform orifice.

Larva 2nd stage. Size ·42 mm. × ·3 mm.

Shape elliptical, broader in proportion than the first stage. Dorsum flat: abdominal segments fairly distinct. Eyes maroon. Two short setæ on cephalic margin, two fairly long setæ caudad on margin and two short setæ caudo-laterally on margin. The setæ caudad on margin spring from small tubercles. Vasiform orifice as in pupa but larger in proportion.

Larva 3rd stage. Size ·7 mm. × ·53 mm.

Shape elliptical, broad for its length. Colour light yellow. Dorsum flat, sometimes slightly rounded. Thoracic and abdominal segments clearly discernible. With the exception of the central area, the surface of the dorsum is covered with coarse granular striations which extend to the margin. Vasiform orifice essentially the same as in later stages. Setæ as in previous stage. In some cases there is a slight line running from thorax cephalad to margin and faint indications of the two radial yellow bands running from thorax to cephalo-lateral margins. The channelled passage running from the posterior extremity of the vasiform orifice caudad to margin and the two ridges situated one on each side of the vasiform orifice and the channelled passage which are present in the pupa, first appear in this stage.

Larva 4th stage. Size 1·05 mm. × ·76 mm.

Characters essentially as in pupa.

Puparium. Size 1·55 mm. × 1·23 mm.

Shape oval. Colour translucent white, with in most cases a tinge of yellow, two yellow pigment spots usually present on the first two segments of the abdomen. As the insect develops within the entire thorax and abdomen become yellow and opaque. Dorsum slightly convex, the surface, with the exception of the central area, covered with granular striations which radiate to the margin. Abdomen and abdom-

inal segments clearly defined. Sides and divisions of thorax apparent, the sides being bounded by a three-lobed line. Three faint lines running from suture between pro and mesothorax, one cephalad and two cephalo-laterally to margin. The cephalo-lateral lines are really more or less clearly defined yellow bands. In some specimens a fairly broad distinct margin can be observed, but in others the margin gradually merges into the central dorsal area, there being no well defined inner edge. In some the margin is extremely pronounced but this is apparently only the case when the insect is parasitized. As in the larvæ of the three preceding stages there are two small setæ cephalad on margin and four (the two inner long and placed on tubercles) on the caudal margin. Vasiform orifice conical, apex pointing caudad; corners rounded. Anterior margin flat. Edge of orifice tinged with brown. Caudad there is a channelled passage extending to margin. Operculum broader than long, nearly filling aperture of vasiform orifice. Anterior margin flat, posterior margin concave, lateral margins convex and angled inwards to posterior margin. Corners rounded. Colour brown, posterior edge darkest. Lingula long, cylindrical, spatulate at tip. It projects about one-third its length beyond the operculum. Colour brown. There are two rounded yellow ridges which lie one on each side of the vasiform orifice. They are prolonged caudad to margin. The channelled passage is situated between them. The two long caudal setæ are situated on the end of these ridges. Small tufts of brown wax are secreted at margin at end of these ridges and also where the cephalo-lateral bands touch the margin. There is an extremely light and narrow marginal fringe of wax. Normally the pupa is semitransparent, flat, and its lower surface adheres closely to the surface of the leaf. The longitudinal cephalic, and radial cephalo-lateral lines are then fairly distinct. As the pupa matures the dorsum becomes convex, the central area becomes yellow and the margin turns an opaque white. The cephalic and cephalo-lateral radial lines are then very distinct. Parasitized pupæ however have an entirely different appearance. The insect is then more or less opaque, the colour ranging from a uniform yellow through shades of brown and red brown to black. Usually however the parasitized pupa has two dark brown blotches one on the thoracic and one on the abdominal region, the rest of the dorsum being of a yellow or cream colour. When the parasite pupates it shows up as a brown and black patch within the central area of the dorsum. The dorsum of a parasitized pupa is invariably highly convex, almost globular in fact. Pupæ from which the parasite has emerged are of a dark yellow or brown colour, while those which develop normally and from which the insects have emerged in due course are of a dull semitrans-

parent white colour. The chalcid parasitising this insect has its head and thorax black, abdomen brown.

Adult female. Size 1·1 mm. Wing 1·16 mm. × ·52 mm.

Head and thorax light brown, abdomen yellow. Ventrally last two segments of abdomen tinged with grey along centre. Legs semitransparent, tinged with grey, joints yellow. Eyes reniform, maroon. Wings white with three faint bands of grey running diagonally across wing. Nervure dark grey where the bands cross it. Hind wing immaculate. Body and legs powdered with white meal. Antennæ ·32 mm. in length. Formula 3, 2, 7, (4, 5, 6,) 1. The first joint is short and flat; the second joint stout, pyriform, about three times the length of joint one; the third joint long, thin, cylindrical, about two-and-a-half times the length of joint two; the fourth, fifth, and sixth joints equal, the three together about equalling joint three in length; the seventh joint thin, slightly longer than joint six.

Vasiform orifice oval, anterior edge flattened. Operculum similar in shape but slightly smaller being only about two-thirds the size of the vasiform orifice. The posterior edge is concave. Lingula long, cylindrical, projecting about one-third of its length beyond operculum.

Adult male. Length ·95 mm. Wing 1·05 mm. × ·48 mm. Antennæ ·25 mm.

Markings of wing similar to that in female. Entire body yellow, legs as in female. Two small tubercles on last segment of abdomen just above forcipate process. I have found this species on pepul (*Ficus religiosa*) in and around Calcutta. It is extremely abundant after the rains (October-November).

5. *Aleurodes simula* n. sp. Plate III, Figs. 1–14.

Egg. Size ·2 mm. × ·09 mm.

Colour light yellow when first laid, afterwards turning brown. Peduncle about one-fourth length of egg. Examined while still within the body of the female the eggs are light yellow. The peduncle is curved inwards and pressed against the egg. Colour of peduncle pink, basal end of egg fairly dark yellow.

Larva 1st stage. Size ·25 mm. × ·15 mm.

Shape elliptical. Colour semitransparent yellow; two yellow pigment patches in centre of abdominal region. There are a series of 34 long hairs right around margin. The four hairs furthest cephalad are grouped in two pairs placed some distance apart. Of the six hairs on caudal margin the inner pair long, the second pair short, and the third pair long. The 24 other setæ are shorter than the long caudal setæ, they are situated at equal distances apart on the lateral margins. Vasiform orifice as in the pupa-case, but the operculum is larger proportion-

ately, and the lateral margins of the orifice are somewhat incurved posteriorly beyond the operculum. Eyes maroon. Abdominal segments distinct. Antennæ and legs present. The artist has drawn the vasiform orifice as seen by him through the transparent body.

Larva 2nd stage. Size ·45 mm. × ·32 mm.

Shape elliptical; colour yellow. Two yellow pigment patches in centre of abdominal region. Two curved hairs caudad on margin. Vasiform orifice as in the pupa-case, but the orifice is situated quite close to the margin. Abdominal segments distinct. Eyes maroon. A marginal fringe of stout, cylindrical, waxy filaments which are placed quite close together.

Larva 3rd stage. Size ·7 mm. × ·5 mm.

Shape elliptical, margin at thorax angled slightly outwards. Dorsum almost flat. Colour yellow. Two setæ caudad, and two setæ placed caudolaterally on margin. A marginal fringe of stout, cylindrical wax filaments. Eyes maroon. Abdominal segments distinct. Dorsum granular near margin. Margin broad, faintly demarcated mesad, and deeply striated radially. There is a distinct yellow band extending from the posterior extremity of the vasiform orifice caudad to margin. There are faint indications of the two radial thoracic bands so conspicuous in the pupa. They end, as also does the band extending caudad to margin, in five separate brown horizontal pores which secrete a small quantity of brown wax. Dorsum covered with a large number of extremely minute circular pores.

Larva 4th stage. Size 1·25 mm. × 1 mm.

Similar to pupa-case except in size, it is also flatter.

Puparium. Size. 1·86 mm. × 1·52 mm.

Shape oval, anteriorly the thoracic margins angled outwards, giving the anterior end a somewhat square appearance. Colour bright yellow. Dorsum at first somewhat flat, later turning fairly convex. Three ridges on dorsum, two radiating from thorax to cephalo-thoracic margins, and one from the posterior end of the vasiform orifice caudad to margin. These ridges are dark yellow, blotched with grey. They end marginally in five stout distinct brown pores which produce a small quantity of brown fluffy wax. Margin broad, demarcated mesad by a fairly broad distinct white band the inner edge of which is dark brown. Margin with strongly marked radial striations, the dorsum also marked around the central area, but the markings are more granular than striated. A small quantity of short stout waxy filaments produced from marginal pores spaced some distance apart. There are also a series of submarginal pores which produce finer and longer wax filaments. They are also spaced some distance apart. There are two small slender setæ on cephalic, and two

similar but smaller setæ on lateral margins. Surface of dorsum and especially of the margin covered with a very great number of extremely minute circular pores which tend to form detached groups. These pores are also present over the radial patches, but the grouping does not differ from the rest of the margin, the pores not being arranged in any sort of pattern.

The margin of the pupa-case turns quite white a short time before the adult emerges. Vasiform orifice conical, apex pointing caudad. Anterior margin flat. Lateral margins sloping inwards; the sloping surface with six ridges on each side. Operculum rhomboidal; the posterior margin somewhat incurved. The operculum extends to about or a little beyond the centre of the vasiform orifice. Surface setose, colour light brown. Lingula two-jointed, lower joint short, stout. Upper joint club-shaped. The lingula extends for one-third its length beyond operculum; the surface setose, colour brown. Two long hairs spring from near the tip of the lingula and extend some distance beyond the vasiform orifice.

Pupa extracted from puparium.

Head fairly broad, colour yellow, the ocelli lighter in colour. Thorax rather dark yellow, abdomen light yellow. Eyes dark maroon. Unfolded wings dark grey. Legs almost transparent, well formed, setose. Sides of abdomen flattened and spread out. Abdominal segments fairly distinct but the vasiform orifice cannot be made out. Antennæ not noticeable in the specimen examined. When the adult emerges from the pupa-case the dorsum splits up not only from the cephalic margin to thorax, and across the thorax, but also right round the inner edge of the margin so that in empty pupal cases the anterior portion of the dorsum is usually missing. I have observed no parasites on this species.

Adult female. Length 1·9 mm. Wing. Size 1·9 mm. × ·85 mm.

Body light yellow; antennæ and legs semi-transparent white. Tip of mentum grey. A lateral grey stripe on each side of the first segment of the abdomen, and dorsally a rather broad diagonal grey patch on each side of the same segment. Dorsally each abdominal segment dark grey nearly the entire width of the body. An oval grey plate situated on the dorsal surface of the last segment of the abdomen. It encloses the vasiform orifice. Ventrally the abdomen covered with fine short hairs. Body and legs covered with white meal. Eyes reniform almost divided; colour dark maroon. Wings immaculate. Vasiform orifice broadly conical, the anterior edge somewhat produced and with a flat indenture in the centre. Operculum cordate, apex pointing cephalad. Posterior margin incurved; lateral margins dark and wavy. The operculum extends nearly the whole length of the orifice, but is somewhat narrower. Colour dark

grey. Lingula cylindrical; it projects to the posterior edge of the vasiform orifice. End almost flat. Only the part which projects beyond the operculum can be made out. Colour grey. Antennæ length ·5 mm. Formula (3, 6,) (2, 4, 5,) 7, 1. Joint one short, flat; joint two subpyriform, about twice length of joint one; joints three and six equal in length, each about twice the length of joint two; joints four and five each equal in length to joint two; joint seven short, thin, and tapering to a point, about one-third length of joint six.

Adult male. Length 1·7 mm. Wing. 1·5 mm. × ·77 mm.

Colour, etc., much as in the female. The antennæ however are enormously developed, being proportionately about twice as long as those in the female. Length ·9 mm. Formula 5, 3, (6, 7,) 2, 4, 1. Joint five is very long, being nearly equal to all the others together. Joint one short flat; joint two subpyriform, twice length of joint one; joint three fairly long, one-and-a-half times length of joint two; joint four short, less than half the length of joint three; joint five long almost equal to all the other joints together; joints six and seven equal, together about equal to joints three and four. The antennæ are heavily ringed and it is extremely difficult to make out the joints. The under surface of the abdomen covered with a large quantity of white fluff.

This species occurs in great abundance on the Simul tree (*Bombyx malabaricum*) in Calcutta. The leaves are thickly covered with the insect; they become yellow and spotted wherever an insect is attached and are ultimately killed. Superficially the insect somewhat resembles *A. eugeniæ*, Mask. There are the same radiating dorsal patches and the dorsum is similarly striated. They differ however in the shape of the pupa-case, and the shape of the vasiform orifice. *A. simula* has a slight marginal fringe and there are four setæ on the margin. The radiating dorsal patches are quite different in the two insects. In *A. simula* these patches are not formed by closely apposed pores but are yellow bands striated with grey. The thoracic radial patches are also true ridges, being elevated above the surface of the dorsum. All three patches in this species end not in a single aperture or pore opening dorsally, but in five stout brown horizontal pores which secrete a small quantity of fluffy brown wax. The dorsum in this species is covered with a large number of extremely minute circular pores; the margin is also broad and clearly defined.

Mr. Maskell was mistaken in assuming that the three radial patches were sufficient evidence to prove the close relationship of *A. eugeniæ* and *A. eugeniæ* var. *aurantii*. As a matter of fact many of the Indian Aleurodidæ possess this characteristic, however widely different they may otherwise be.

Aleurodes bambusæ n. sp. Plate IV, Figs. 1–9.

Egg. Length ·25 mm. × ·11 mm.

Colour light brown. Surface sculptured with hexagons. Attached in an upright position to leaf by a short peduncle.

Larva 1st stage. Size ·35 mm. × ·2 mm.

Shape elliptical; narrow for its length. Colour deep black; dark brown under the microscope. The dorsum is completely hidden by a quantity of white fluff which is produced by a series of submarginal pores. There is an elevated mesio-dorsal ridge extending anteriorly almost to the margin and posteriorly to the vasiform orifice. Segments of abdomen fairly distinct. Margin crenulated, bearing a series of closely apposed pores which produce a regular but somewhat short horizontal fringe. Ventrally just within the margin a series of pores which produce a scanty white secretion. There are four long setæ on cephalic and four on caudal margins. On the dorsum there are four long stout curved spines which are situated a pair on the cephalic and a pair on the anterior edge of the abdominal region. They are placed on the sides of the medio dorsal ridge. The spines point backwards. Each spine is about half the length of the body, the anterior pair being slightly longer. Two short stout curved spines are situated one on each side of the vasiform orifice. Vasiform orifice large elevated on a tubercle. It is apparently similar to that in the puparium but owing to the colour is difficult to make out.

Larva 2nd stage. Size ·55 mm. × ·3 mm.

Similar except in size to larva 3rd stage.

Larva 3rd stage. Size 1 mm. × ·55 mm.

Shape elliptical, somewhat broader proportionately than in the first stage. Colour dense black. There is a distinct mesio dorsal ridge which is somewhat slighter than in the preceding stage. Abdominal segments distinct. Area surrounding vasiform orifice darker than the rest of the abdomen. Margin broad crenulated. Mesad the margin ends at a broad ridge which separates it from the rest of the dorsum. Along its edge are a series of large closely apposed pores which produce a short but abundant horizontal fringe of wax. The upper surface of the margin bears a large number of extremely minute pores. These pores produce a quantity of white fluffy wax filaments which curve inwards and cover the dorsum. Ventrally a little within the margin there are a series of pores which produce a small quantity of wax. The dorsum is covered with a number of stout spines. There are: a pair on the cephalic region at end of mesio dorsal ridge and nearly on the margin; two pairs placed fairly close together on the cephalic region; a pair placed widely apart on the thoracic region; immediately behind this pair there

are two pairs placed fairly close together on the lower edge of the mesio dorsal ridge; a pair of spines on each of the 3rd, 4th, and 5th abdominal segments; and two stout curved spines, one on each side of the vasiform orifice. There are two short setæ, one on each side of the vasiform orifice and two fairly long setæ caudad on margin. The vasiform orifice as in preceding stages, but in some specimens the lingula appears large and dumb-bell shaped.

Larva 4th stage. Size 1·4 mm. × ·9 mm.

Shape elliptical, anterior edge abruptly conical. Colour dense black. Mesio dorsal ridge as in preceding stages. A broad crenulated margin which ends mesad in an elevated ridge which separates it from the rest of the dorsum. The margin ends in a series of large closely apposed pores which produce a short thick marginal fringe of white wax. The upper surface of the margin is covered with a large number of minute pores which produce a quantity of white fluff, which curving inwards covers the dorsum. Segments of abdomen distinct. The dorsum is covered with a large number of stout spines which lie: five pairs on the cephalic region; four pairs on the thoracic region, and five pairs on the abdominal segments. There is also a stout curved pair situated one on each side of the vasiform orifice. There are two short setæ, one on each side of the vasiform orifice and a slightly longer pair caudad on margin. Vasiform orifice large in proportion to its size as compared to the vasiform orifice in the puparium.

Puparium. Size 2·1 mm. × 1·4 mm.

Shape elliptical, broadest caudad. Colour dense black. Distinct mesio dorsal ridge which is narrow and sharp anteriorly, and broad and rounded posteriorly. From this ridge there are a series of five ridges which mark out the abdominal segments. Margin broad, crenulated; bearing on its upper surface a large number of minute pores which produce a quantity of white wax filaments which curling inwards conceal the dorsum. There are a series of closely apposed marginal pores which produce a short but abundant horizontal secretion of wax. There are ventrally on margin a series of pores which produce a small quantity of wax. The dorsum is covered with a large number of short but stout spines. These spines are grouped as follows. There are thirty hooked spines forming a ring around the dorsum just within the margin. The other spines are shorter and are situated as follows. A double row of eight spines across the cephalic region; four spines on the thoracic region; sixteen spines in a row down the mesio dorsal ridge on the abdominal region; two rows of three spines, one row on each side of the mesio dorsal ridge on 1st and 2nd abdominal segments; two rows of two spines placed similarly on third and fourth segments and one spine on each

side of the mesio dorsal ridge on the 5th segment. A pair of short stout spines placed, one on each side of the vasiform orifice. Two long setæ caudad and two cephalad on margin. The vasiform orifice is situated on a short tubercle at the posterior end of the mesio dorsal ridge. Shape oval. Operculum similar in shape but somewhat smaller, the lower half apparently slightly ridged. Lingula indistinct, shape rectangular, broader than long. It is completely covered by the operculum.

Adult form unknown.

This Aleurodid occurs plentifully on various species of bamboo in the vicinity of Calcutta. As a rule only a few leaves in a bamboo clump are attacked by the insect. I have, however, sometimes found it occurring in very large numbers in some bamboo clumps. It then undoubtedly is a rather serious pest as frequently most of the leaves are then killed. The insect is kept in check by a parasite, presumably a chalcid, as large numbers of dead insects can always be found which have the minute hole on the dorsum made by the parasite for its exit. I have so far obtained no specimens of the parasite. When this aleurodid is detached from the leaf it will be observed that the portion of the leaf beneath the insect is yellow and discoloured. As a rule the exuviæ of the preceding stages remains attached to the spines on the dorsum.

Aleurodes leakii n. sp. Plate V, Figs. 4–5.

I obtained specimens of this insect off both Natal (*I. arrecta*) and ordinary indigo (*Indigofera tinctoria*) at Dalsing Serai, Behar, in the month of May 1902. As seen with the naked eye the pupæ and larvæ are yellowish in colour. I noticed one peculiarity with regard to this species; the scales invariably occur on the upper surface of the leaves. This is rather an unusual feature. The insect itself was not common enough to constitute a pest. It may possibly however at other times of the year be present in larger numbers and so prove a factor amongst the numerous insect pests indigo has to contend with. I have found it to be far commoner on Natal than on ordinary indigo. Considering that in the future the Natal plant will almost certainly be grown to a large extent owing to its superiority over the ordinary indigo the suppression of this pest may at some time have to be taken in hand. The scales themselves as a rule occur rather sparsely, two or three on each leaflet. I have however occasionally found them in fairly large numbers on single leaflets.

Egg. Size ·2 mm. × ·1 mm.

Colour yellowish brown. The egg is attached to the leaf in an upright position by a short peduncle or stalk.

Larva probably 2nd stage. Size 1·05 mm. × ·76 mm.

Shape elliptical; colour whitish-yellow, a few yellowish-brown

marks along the centre of dorsum: dorsum covered with coarse granulations. Segments of body more or less distinct along dorsum. Margin of case broad, crenulated; there is no wax fringe. Dorsum flattish, sometimes slightly convex. Vasiform orifice conical, very much elongated, anterior edge concave, sides emarginate. Abdomen distinctly cleft from the vasiform orifice to the posterior margin, the edge of which is slightly incurved to meet the cleft; the vasiform orifice is over one-half the length of the cleft. Operculum attached anteriorly to vasiform orifice, sub-elliptical, broader than long, Lingula narrow, broadest at tip, narrowest a little above the middle. Tip conical, projecting beyond operculum about one-and-a-half times the length of the operculum. It is slightly shorter than the vasiform orifice within which it lies.

Larva. Last stage. Size 1·1 mm. × ·76 mm.

Shape elliptical. Dorsum almost transparent. Segments more or less distinct along dorsum. Insect itself more or less distinct beneath the dorsum. Colour of maturing insect orange to yellow, eyes maroon. Margin of dorsum broad and transparent, the rest of the body faint greenish-yellow. Vasiform orifice lemon-yellow the operculum slightly darker in shade. Lingula similar in colour. Vasiform orifice operculum and lingula as in preceding stage. No trace of setæ or hairs, either on dorsum or on margin of body. Margin extremely flat, the dorsum rises with a slight curve from margin.

Puparium. Size 1·15 mm. × ·84. mm.

Colour translucent, faintly tinged with yellow. Insect itself clearly discernable beneath the dorsum; colour yellow, eyes dark red. The rest as in larval stages.

Adult female. Length ·85 mm. Wing 1·05 mm. × ·35 mm.

Colour of body brownish-yellow; legs and antennæ yellow. Length of antennæ ·22 mm., seven jointed: joint one short, subpyriform: joint two stout, slightly longer than joint one: joint three two and a half times length of joint two: joint four short, less than one-third joint three in length: joints five and six equal, slightly shorter than joint two: joint seven long and tapering, half the length of joint three. Wings immaculate. Eyes reniform, undivided.

I have been unable to obtain specimens of the adult male.

I have much pleasure in naming this species after Mr. H. M. Leake, who assisted me in collecting specimens and was kind enough to mount examples for the microscope.

Aleurodes hoyæ n. sp. Plate V, Figs. 1–3.

This species is fairly common in and around Calcutta on Hoya sp. I have observed it in the years 1900, 1901, and 1902. Although it is

comparatively easy to obtain larvæ and pupæ I had the greatest difficulty in rearing adults as nearly every one of the many hundred pupæ I have examined was parasited; the parasite, a minute hymenopteron (a chalcid) cutting a neat circular hole on the dorsal surface of the puparium when escaping. This species is I believe unique in having the wings of the adult of a uniform plum-blue colour. Owing to this peculiarity it has a remarkably moth-like appearance.

Egg. Size ·25 mm. × ·1 mm.

Light brown, curved, surface sculptured with lines forming irregular hexagons. Peduncle one-sixth length of egg.

Larva first stage. Size ·9 mm. × ·68 mm.

Shape elongate elliptical. Colour light yellowish-brown. At this stage the larva is somewhat dissimilar in appearance to more advanced larvæ, the larva being in some cases comparatively narrow and long. Dorsum flat and minutely granulated. There is a slight dorsal ridge.

Larva 2nd stage. Size 1·4 mm. × 1·2 mm.

Shape elliptical. Colour light-brown. Dorsum flat and granular. There is a delicate series of marginal wax tubes from which a small quantity of wax filaments extrude; filaments short. Vasiform orifice similar in shape to that in the third stage. Operculum darker in colour then the rest of the body. Caudal margin slightly incurved, with two wax tubes which are larger than those on the margin, situated one on each side of the curve. They produce two fairly long wax filaments.

Larva 3rd stage. Size 1·6 mm. × 1·4 mm.

Colour from light to dark-brown; centre of dorsum darkest, there being a wide band lighter than the centre along edge of dorsum. Shape elliptical, flattish. Broad medio dorsal ridge on which the abdominal and thoracic segments are clearly discernible. Dorsum granular in appearance. The centre of dorsum has small circular granulations, those on the outer edge being coarser and oval in shape. A series of minute closely apposed wax tubes along margin. There are sometimes traces of a waxy fringe. Vasiform orifice cordate; anterior margin flattish or slightly incurved. Operculum similar in shape and extending almost to the caudal extremity of the vasiform orifice. Edge of vasiform orifice tinged with brown as also the operculum.

Puparium. Size 1·62 mm. × 1·43 mm.

Colour black. Shape elliptical. Some specimens, however, are almost circular. The dorsum is granular and rounded. The medio-dorsal ridge so conspucuous in the larva is far less prominent though still discernible. Margin flat and extremely narrow. Vasiform orifice cordate, anterior margin flattish. Owing to the extremely dense black colour of the dorsum it is difficult to make out the details of the vasiform orifice

even after boiling in caustic potash. It however appears to be similar to that in the larva.

Adult female. Size 1·85 mm. Wing 1·55 mm. × ·67 mm.

Body brown. Legs and antennæ yellowish-brown. Eyes reniform, dark red-brown in colour. Antennæ ·63 mm. Seven jointed. Joint one short subpyriform; joint two stout, one and a half times the length of joint one; joint three long, cylindrical, about twice the length of joint two; joint four short, slightly shorter than joint two; joints five, six, seven equal, each about half the length of joint three. Vasiform orifice obovate, operculum small; anterior and posterior margins flat, lateral margins curving outwards from anterior margin and incurving to meet posterior margin. Lingula V shaped, upper extremity broadest, narrowing in centre and broadening out slightly at tip. The tip itself is conical. It projects slightly beyond vasiform orifice; wing purplish-blue in colour, having a bloom on it like that seen on a plum. Edges of the wing reddish along margin. A series of closely apposed globular projections each bearing two delicate setæ.

I only succeeded in rearing three adult females. I have never obtained the male.

Chapter VI.

Description of Aleurodidæ previously described from the Indian Region.

Only a few species of this family have been described so far from India and Ceylon. For the sake of convenience I have thought it advisable to include the full descriptions.

The following species have so far been described.

Aleurodes eugeniæ Mask.

Aleurodes eugeniæ Mask. var. *aurantii* Mask.

Aleurodes barodensis Mask.

Aleurodes cotesii Mask.

Aleurodes piperis Mask.

Aleurodes nubilans Buckton.

Three other species in all have been described from the Oriental Region. *A. gossypii* Fitch, *A. lactea* Zehnt. and *A. longicornis* Zehnt. Their descriptions will be given in Part II.

Aleurodes eugeniæ Mask.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 430, Indian Museum Notes, Vol. IV, No. 2, p. 52.

Larva dull white or grey, or slightly yellowish; form roundly elliptical, the anterior edge very slightly compressed; dorsum scarcely convex; length about $\frac{1}{40}$ inch. Dorsum marked with very delicate radiating striæ. Margin without either fringe or hairs, and not at all thick-

ened, but finely fluted and minutely crenulated. Three marginal depressions and radiating dorsal patches as described below in the pupa.

Pupa-case very pale yellow, or greyish; dorsum very slightly convex; form roundly elliptical or subcircular; length about one-twentieth in. as a rule, but reaching one-fifteenth in. The enclosed pupa is conspicuous dorsally, dark brown, the segments fairly distinct; on turning over the case the rudimentary feet may be made out rather confusedly, and the antennæ more faintly. Dorsum of the case marked with radiating striæ, more clear than those of the larva: these striæ are most conspicuous near the margin, which is not at all thickened, but marked with narrow but deep channels dividing it into broad segments. At three points in the margin there are small concave depressions, one on each side opposite the rostrum, and one at the abdominal extremity. Corresponding with these, on the dorsum, are three very faint radiating dotted patches: when viewed by transmitted light, these patches are seen to be formed of a lace-like pattern, with small, irregular cells, and at their extremity they end in a circular orifice deeply crenulated; the anterior pair extend from the rostrum to the margin, the posterior one from the vasiform orifice to the margin. Vasiform orifice with straight anterior edge, sides and end regularly convex; operculum nearly covering the orifice, and of similar form; lingula short, almost regularly cylindrical, scarcely extending beyond the operculum. There is no marginal fringe, nor are there any dorsal or marginal hairs.

Adult form unknown.

Hab. In India, on *Eugeniæ jambolana*. My specimens were sent by Dr. Alcock, Superintendent of the Indian Museum, Calcutta. From the great numbers on the leaves it would seem that the insect is injurious. They came from Poona.

A short description of this insect was sent by me to Dr. Alcock for insertion in "Indian Museum Notes;" but I have included it again here in order to note the distinctions which separate it, firstly, from *A. eugeniæ*, var. *aurantii*, next described, and secondly, from *A. citri* (Ashmead), Riley and Howard, *Insect Life*, 1893, p. 219. As to the first my descriptions and figures will suffice. From *A. citri* the species differs in the entire absence of marginal and dorsal hairs in the larva and in the three radiating lace-work patches, of which no mention is made by Riley and Howard, but which are conspicuous characters of *A. eugeniæ*.

This insect and its variety, with *A. citri*, *A. melicyti*, and others, may be placed in a series of which *A. proletella*, Linn., may be taken as the type.

Aleurodes eugeniæ, Maskell, var. *Aurantii*, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 431, Ind. Mus. Notes,

Vol. IV, No. III, p. 144. Larva very pale-yellow, sometimes almost white; form roundly elliptical, flattish; length about one-fortieth in. Dorsum striated, but the striations are very faint, except near the margin. Margin not at all thickened, finely fluted and crenulated, bearing no hairs or fringe. There are three small marginal depressions and three dorsal patches as in the pupa.

Pupa-case very pale yellow, roundly elliptical or subcircular, flattish and thin; length about one-twenty-fourth in., reaching sometimes as much as one-sixteenth in. The enclosed pupa is only faintly discernible dorsally, rather darker than the case, the abdominal segments moderately distinct; on turning over the case the rudimentary organs are less confused than in *A. eugeniæ*. Dorsum of the case very finely marked with radiating striæ, which are a little more conspicuous near the margin. Margin not thickened, almost entire, divided by deep narrow channels into segments narrower than those of *A. eugeniæ*. There are three marginal depressions, two opposite the rostrum and one at the abdominal extremity, and three radiating patches terminating at these depressions; the patches end (as in the type) in crenulated circular orifices, but are composed of great numbers of very minute circular pores or dots, which do not form a lace-work pattern. Vasiform orifice subtrapezoidal or subelliptical, broader than long; operculum nearly fitting the orifice; lingula very short, cylindrical with a dilated end, sometimes obsolete.

Adult form unknown.

Hab. In India, on *Citrus aurantium*. Mr. Cotes, late of the Indian Museum, Calcutta, sent me some orange leaves from "North-West Himalayas," thickly covered with this insect.

I attach this as a variety to *A. eugeniæ* on account of the similarity in several respects, notably in the dorsal radiating patches, though it differs in some others. It has none of the marginal or dorsal characters of *A. citri*, Riley and Howard.

Aleurodes barodensis, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 424, Ind. Mus. Notes, Vol. IV, No. III, p. 143. Eggs orange coloured, rather large, oval, pedunculated, length about one-one-sixtieth in. The eggs and empty shells are found in large numbers on the leaf.

Larva dark-brown, becoming later almost black; elongated elliptical; slightly convex; abdominal segments fairly distinct, length about one-forty-fifth in. Margin minutely crenulated and bearing a short white waxy fringe, which is frequently very fragmentary or absent. Dorsum bearing, within the margin, a row of about thirty-two small simple circular pores; within these is a transverse row of four on the

anterior thoracic region, another transverse row of four on the anterior abdominal region, a longitudinal row of four on each side of the abdomen, and one on each side of the vasiform orifice. Vasiform orifice subconical, the posterior extremity slightly produced; operculum short, rounded, subconical; lingula cylindrical at the base, afterwards widened, finally tapering, not quite reaching the edge of the orifice.

Pupa-case very dark-brown or glossy-black; very elongated, elliptical, with sides nearly straight, the width only about one-third of the length. Dorsum sometimes slightly convex, sometimes flat, sometimes slightly concave; abdominal segments indistinct. Vasiform orifice apparently as in the larva, but difficult to make out on account of the very dark colour of the case. Margin crenulated and bearing a very elegant, long, snowy-white fringe of slender waxy cylindrical tubes. There is frequently some white powdery meal on the dorsum, which probably bears pores as in the larva, but it is most difficult to detect them. The ventral surface is flat, brown; the rudimentary organs are not distinct, owing to the dark colour.

Adult form unknown.

Hab. In India, on *Saccharum officinale.* My specimens were sent by Mr. Cotes, late of the Indian Museum, Calcutta, from Baroda. He informed me they were rather damaging to the sugarcane in those parts.

The very elongated form is distinctive, besides the black colour.

Aleurodes cotesii, Maskell.

Transt., N.Z. Inst, Vol. XXVIII, 1895, p. 427, Ind. Mus. Notes, Vol. IV, No. III, p. 145.

Larva yellow, the median region darker than the margin; form elliptical; length about one-fortieth in. In the earliest state only very faint indications of the insect itself appear, and the whole is very thin and flat; later on the enclosed future pupa begins to be visible, and the ventral surface becomes more convex; the eyes also appear. The larval integument becomes too small for the growing insect, and splits longitudinally; and in the early pupal state it may be seen attached along the dorsal edges of the pupa-case. Margins somewhat thickened, the adjacent tubes forming minute crenulations, and within it the dorsum bears numbers of very small circular pores; from these and from the marginal tubes is produced a quantity of white waxy matter, some of which covers the dorsum in scattered patches, and the rest spreads round the larva in a very long fringe of delicate threads, frequently much longer than the insect itself! This waxy matter is very brittle, and, as a rule, the whole surface of a leaf is powdered over with the fragments, making the leaf look as if mildewed.

The pupa-case, in the earliest stage, scarcely distinguishable from the late larva; afterwards as the insect grows, it becomes much thicker. The form remains elliptical; the length reaches about one-thirtieth in. The dorsal disk is slightly convex, flattened towards the margin; it is larger than the ventral disk, and slightly overlaps the sides, which are vertical. The hollow thus formed is covered by a ring of thin white wax, and there is also a plate of wax beneath the ventral surface; portions of this ring and of the plate are frequently seen amongst the long threads of the larva. The pupal margin is crenulated, but bears no fringe, and the dorsum has no pores or wax. The outline of the enclosed pupa may be made out indistinctly on the dorsum, and the rudimentary organs ventrally on turning over the case. Vasiform orifice subconical, with regularly convex sides, the anterior edge concave; operculum subelliptical; lingula very short, not extending beyond the operculum.

Adult form unknown.

Hab. In India, on *Rosa*. My specimens were sent by Mr. Cotes, late of the Indian Museum Calcutta. They came from Quetta, Baluchistan. I have named the species after him.

The overlapping of the sides by the dorsal disk of *A. cotesii* is found also in a New Zealand species, *A. fagi*, Maskell, 1889; but that insect has no fringe, the margin bears twenty-four hairs.

Aleurodes piperis, Maskell.

Trans., N.Z. Inst., Vol. XXVIII, 1895, p. 438.

Eggs dark-yellow, elongate-elliptical, transversely striated; length about one-one hundred and forty-fifth in.

Larva very dark-brown or black, very slightly convex, elliptical; length about one-fortieth in. Dorsum bearing long, very black spines of which four are on the cephalic, eight on the thoracic, and ten on the abdominal regions. Margin not thickened, but very distinctly crenulated There seems to be no fringe.

Pupa-case intense glossy black, slightly convex, with a median longitudinal ridge; abdominal segments indistinct. Form elliptical; length about one-twenty-fifth in. Dorsum bearing many long black spines, of which one series of from twenty to twenty-four are submarginal, the others scattered (seemingly about twenty, but very difficult to make out on account of the intense black colour); two of the spines, at the posterior extremity, are longer than the others. Margin with very small crenulations; there is a very short fringe of white wax, which in many specimens is not noticeable. Vasiform orifice broadly rhomboidal with rounded angles, anterior edge slightly concave; operculum semi-elliptical, covering about half the orifice; lingula short, roundly clavate. The larval exuviæ are commonly seen attached by the dorsal spines to the pupa-case.

The pupa extracted from its case is reddish-yellow, the rudimentary feet and antennæ yellow, the rudimentary wings yellow with bands of dark brown, the eyes dark-brown.

Adult form with the thorax red, banded with brown; the abdomen red; genitalia brown; feet and antennæ darkish-yellow, tipped with brown. The antennæ and feet are normal. Forewings with three bands of dark-brown, of which the outer one does not quite reach the margin at the extremity. The genitalia do not exhibit any special features.

Hab. In Ceylon, on (*Piper nigrum ?*). My specimens were sent by Mr. E. E. Green, from Punduloya.

I know of no described species in which the larva and pupa have such strong black spines as this. The wings of the adult are not particularly distinctive, for those of *A. sacchari*, Mask., 1889, have quite similar bands. I have found it extremely difficult to correctly distinguish the dorsal spines on the pupa; and the vasiform orifice also presents much difficulty.

Aleurodes nubilans, Buckton.

Indian Museum Notes, Vol. V, No. 2, p. 36.

Legs long and hairy with dimerous tarsi. Antennæ rather long and with seven (?) joints in the female, which is a larger insect than the male. Wings four, rounded at the apices, and fringed with minute hairs. A single unforked central nervure, not continued to the margin. Membrane smoky in patches with a darker blurred spot. The male smaller with a large thorax, taper abdomen, and furcate at the apex and with hinder legs longest.

The larvæ crowd the undersides of the leaves of the betel in the form of small scales very difficult to detach. They appear like scales of some Coccidæ, but these show no distinct organs such as antennæ, legs, or eyes. Their outer surfaces were more or less spined, and some larvæ were tufted with woolly matter, each thread being formed of a continuous spiracle.

This new Aleurodid was received on betel leaves from the Manager, Court of Wards Estates, Backergunge, who reported that it was doing considerable damage to the plants.

N.B.—This Aleurodid was received and identified before I joined the Entomological Section of the Museum. It is to be regretted that no description was drawn up of the larvæ or pupæ. The types in the Museum are too badly damaged for description. I hope hereafter to describe the earlier stages.

Explanation of Plate II.

All figures much enlarged.

Aleurodes alcocki.

Fig. 1. Larva 1st stage.
2. Leg of larva 1st stage.
3. Antenna of larva 1st stage.
4. Larva 2nd stage.
5. Pupa-case.
6. Vasiform orifice of pupa-case.
7. Margin of pupa-case.
8. Incurved thoracic margin of pupa-case.
9. Wing of adult female.

Aleurodes bengalensis.

Fig. 10. Vasiform orifice of larva 1st stage.
11. Vasiform orifice of larva 2nd stage.
12. Pupa-case.
13. Vasiform orifice of pupa-case.
14. Antenna of adult female.
15. Vasiform orifice of adult female.
16. „ „ „ „ „

Explanation of Plate III.

All figures much enlarged.

Aleurodes simula.

Fig. 1. Egg as seen within the body of the female.
2. Peduncle of egg.
3. Larva 1st stage.
4. Antenna of larva 1st stage.
5. Pupa-case.
6. Vasiform orifice of pupa-case.
7. Outcurved thoracic margin of pupa-case showing pores forming termination of thoracic radial bands.
8. Margin of pupa-case showing the circular pores on dorsum.
9. Pupa extracted from pupa-case.
10. Genital organs of male.
11. Wing of female.
12. Vasiform orifice of female.
13. Antenna of male.
14. „ „ female.

Explanation of Plate IV.

All figures much enlarged, except fig. 1, which is natural size.

Aleurodes bambusæ.

Fig. 1. Insects *in situ* on plant.
2. Larva 1st stage.
3. Ventral pores near margin of do.
4. Larva 2nd stage.
5. Larva 4th stage.
6. Margin of case of do.
7. Puparium.
8. Margin of case of do.
9. Vasiform orifice of do.

Explanation of Plate V.

All figures much enlarged.

Aleurodes hoyæ.

Fig. 1. Puparium.
2. Vasiform orifice of do.
3. Wing of adult female.

Aleurodes leakii.

Fig. 4. Puparium.
5. Vasiform orifice of do.

Aleurodes religiosa.

Fig. 6. Larva 1st stage.
7. Vasiform orifice of do.
8. Puparium.
9. Vasiform orifice of do.

Aleurodes quaintancei.

Fig 10. Puparium.
11. Parasited puparium.
12. Vasiform orifice of puparium.
13. Wing of adult female.
14. Antenna of do.

Explanation of Plate VI.

All figures much enlarged.

Fig. 1. Adult female.
2. Antennæ of do.
3. Edge of forewing of do.
4. Typical forewing of Aleurodes.

Fig. 5. Typical forewing of Aleurodicus.
6. Leg of adult.
7. Leg showing three claws on tarsus.
8. Male genital organs and vasiform orifice, dorsal view.
9. Side view of vasiform orifice of male.
10. Female genital organs, ventral view.
11. Head of adult, side view.
12. „ „ „ front view.
13. Egg.
14. Typical vasiform orifice.

Silajit: an ancient Eastern Medicine.—*By* David Hooper, F.C.S.

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One of the most peculiar medicinal substances of the East is that called Silajit or Shilajatu. It is known by the former name in Hindi and Persian, and by the latter in Bengali and Sanskrit. The meaning of the term is derived from *Sila*=a stone, and *jatu*=produce or essence. It may therefore be regarded as a substance born of the rock, essence of stone, or, more literally, "rock sweat."

The localities in which this article is reported to be found are confined to Northern India. It is obtained from the lower, central and upper ranges of the Himalayas and the Vindhyan hills, and is procurable in Simla, Mussoorie, and Katmandu. In Vadarikasvan, near Hardwar, a sacred retreat at the foot of the Himalayas, it is fairly abundant. It is brought down by Bhuteas and other hill tribes, and sold with such commodities as brick tea, incense, gums and precious stones.

The occurrence and formation of silajit is at present somewhat obscure. It appears as an exudation upon rocks, and, according to report, is contained in the substance of the rock. Silajit is collected during the hot weather in May and June, the heat of the sun is said to be necessary in drawing out the extract from the rocks. In Sanskrit works it is stated that silajatu imbibes the therapeutic properties of the metals with which it remains associated. The black variety, which is the most commonly available, is said to possess the properties of iron, and the white variety is said to exert the peculiar action of silver. The manner in which this exudation occurs, and the kinds of rocks which afford it, are matters requiring investigation. The collection is in the hands of shepherds and nomadic tribes, who can, of course, furnish no intelligent